

## Anatomical Study of the Middle Meatus with Emphasis to the Maxillary Ostium and Their Clinical Relevance

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Received: 03/01/2014

Revised: 27/01/2014

Accepted: 03/02/2014

### ABSTRACT

**Introduction:** The anatomical variations of the lateral wall of the nasal cavity may create technical difficulties during endoscopic sinus surgeries. Interventions involving the middle meatus are commonly performed as majority of the paranasal sinuses open into the osteomeatal complex. The present study was therefore designed to provide information on maxillary ostium in relation to the important anatomical landmarks and also about the variations possible in the morphology of the middle meatus.

**Materials and methods:** The present observational study was carried out on 25 sagittal sections of head and neck in the department of Anatomy Kasturba Medical College, Manipal. The nasal septum was removed to visualize the lateral wall. The middle meatus was then studied for the variations possible in the openings of the bulla ethmoidalis and hiatus semilunaris. The distance of the maxillary ostium from the prominent landmarks was measured. The findings were recorded and tabulated.

**Results:** The mean and standard deviations of the parameters were measured. The variations in the middle nasal concha and the bulla ethmoidalis were also observed.

**Conclusion:** This knowledge about the variations in the lateral wall of the nasal cavity is crucial during the endoscopic interventions and for functional endoscopic sinus surgeries.

**Key Words:** Middle meatus, maxillary hiatus, hiatus semilunaris, bulla ethmoidalis

### INTRODUCTION

The middle meatus and hiatus semilunaris are important access pathways to the paranasal sinuses for physicians performing endoscopic procedures. The middle meatus is a passage that underlies the bony prominence of the middle nasal concha and leads to the structures located more laterally on the nasal wall.<sup>[1]</sup> The term hiatus

semilunaris was first used by Zuckerkandl to describe the half-moon shaped gap between the posterior edge of the uncinat process and the anterior edge of the ethmoid bulla.<sup>[2, 3]</sup> The hiatus semilunaris is important clinically because of its relationship to the drainage patterns of the frontal, maxillary, and anterior ethmoidal sinuses.

Various cadaveric and radiological studies have been carried out to identify the variations of the landmarks in nasal anatomy but the morphometric measurements vary considerably.<sup>[4-7]</sup> Interventions involving the middle meatus are commonly performed as majority of the paranasal sinuses open into the osteomeatal complex.

The middle meatus and lateral nasal wall are also subject to wide normal variations that must be distinguished from pathologic changes. Familiarity with the anatomical variations in the middle meatus will increase the safety and effectiveness of functional endoscopic sinus surgeries (FESS). The present study was therefore designed to provide information on maxillary ostium in relation to the important anatomical landmarks and also the variations possible in the morphology of the middle meatus.

## MATERIALS & METHODS

The present observational study was carried out on 25 sagittal sections of head and neck in the department of Anatomy, Kasturba Medical College, Manipal.

The nasal septum was removed to visualize the lateral wall of the nasal cavity. The middle meatus was then studied for the variations possible in the openings of the bulla ethmoidalis and hiatus semilunaris.

The distance of the maxillary ostium (MO) from the anterior nasal spine (ANS), the hard palate (HP), midpoint of the inferior nasal concha (IC) and the distance between the inferior margin of the bulla to the superior margin of inferior concha (B-I) were measured (Figure 1a&b).

The findings were recorded and tabulated. t- test was applied using SPSS version 16. Other variations in the lateral wall of the nasal cavity were also noted.

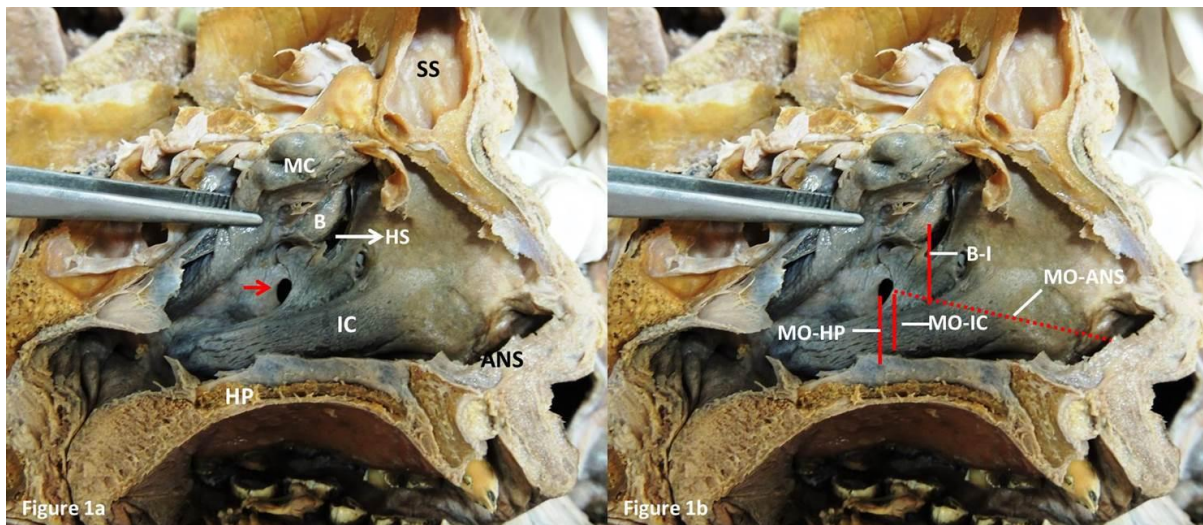


Figure 1a&b: Sagittal section of the cadaveric head and neck and the various measurements taken.

MO: Maxillary ostium (red arrow), ANS: Anterior nasal spine, HP: Hard palate, IC: Inferior nasal concha, B: Bulla ethmoidalis, MC: Middle concha, HS: Hiatus semilunaris, SS: Sphenoidal sinus

## RESULTS

Table 1: Mean and standard deviation of the parameters measured.

Distance in cm	Right side (N=13)	Left side (N=13)
MO-ANS	3.88±0.44	4.04±0.48
MO-HP	2.49±0.4	2.52±0.26
MO-IC	1.97±0.22	2.02±0.39
B-I	0.95±0.37	1.20±0.49

The mean and standard deviations of parameters measured are represented in table 1. Independent sample t-test was applied to compare the means between

right and left sides which did not show any statistical significance.

Variations in the morphology of the middle meatus when observed showed a bifid middle nasal concha (figure 2a), bifid middle nasal concha with a hypertrophied

bullae (figure 2b) and a split middle nasal concha (figure 2c) respectively.

Supernumerary (2 & 3) openings in bulla ethmoidalis were observed i.e., two openings in five cases (figure 3a) and three openings in three cases (figure 3b) respectively.



Figure 2: Variations in the middle meatus.

Figure 2a: Bifid middle nasal concha. Figure 2b: Bifid middle nasal concha with hypertrophied bulla. Figure 2c: Split middle nasal concha.



Figure 3: Multiple (2&3) openings in the bulla ethmoidalis.

## DISCUSSION

Variability of the bony structures located in the maxillary sinus, and of the lateral nasal wall topography, has practical significance during surgical procedures conducted by maxillofacial surgeons or otolaryngologists. Recognition of the nasal anatomic variations is beneficial for identification of the operative limits.

The statistics of the prevalence of anatomic variations are presented differently in various studies and could be the result of

discrepancies in analyzing and studying methods, definitions, racial varieties and the accuracy of studies according to CT-scans. [4-7]

Earlier many authors have reported the width, capacity, and topography of the nasal cavity and maxillary sinus bony structures and have stressed on the fact that precise knowledge of the maxillary sinus and nasal cavity anatomy is essential for conducting maxillo-facial<sup>[8,9]</sup> or laryngological<sup>[10,11]</sup> operations on the sinuses.

The measurements taken in the present study are less explored upon and therefore could provide valuable information regarding maxillary ostium in relation to the important anatomical landmarks and a steadfast approach to the ostium during endoscopic sinus surgeries.

Aeration and secretion of paranasal sinuses travel a tortuous path through openings, fissures and grooves located on the lateral wall of the middle meatus for their effective drainage. During the development and pneumatization of the ethmoid bone, this region is anatomically prone to develop morphological variations. It may create technical difficulties during endoscopic sinus surgeries.

In an endoscopic study bilobed middle nasal concha was observed in 0.5 and 2.8% of the studies [12, 13] while in the present study it was observed in the two cases (figure 2a&b). The latter also showed a hypertrophied bulla ethmoidalis (figure 2b). An abnormal slit in the middle nasal concha was also observed in one of the cases (figure 2c). Such variations may be predisposing factors for the development of rhinosinusitis.

The number of openings in the bulla ethmoidalis when observed also showed variations. Majority of the cases showed a single opening. However a few cases had multiple openings (figure 3a&b).

Although variations in the structures of the lateral nasal wall appear to arise independently and not as a part of the syndrome, certain configurations present together may result in a higher prevalence of sinus diseases.

The present study could therefore be useful in familiarizing with such variations and guiding safe endoscopic procedures.

## CONCLUSION

This study attempts to provide information regarding the location of the

maxillary hiatus in relation to the important landmarks in the lateral wall of the nasal cavity and also the possible anatomical variations of the middle nasal concha and bulla ethmoidalis. These observations in the lateral wall of the nasal cavity are crucial during the endoscopic interventions and for FESS.

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How to cite this article: D Souza A, Ankolekar VA, Bhat KMR et. al. Anatomical study of the middle meatus with emphasis to the maxillary ostium and their clinical relevance. *Int J Health Sci Res.* 2014;4(2):35-39.

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